Space Weather Technical Forecast

Issued on Tuesday, 06 August 2024 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares expected with a chance of isolated X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: High with two X-class flares observed, including an X1.7 at 05/1340 UTC from AR3767 from over the west limb and an X1.1 at 05/1527 UTC from AR3780 in the southeast disc. This is the largest of the nine regions on the Earth-facing disc, and is dominated by a very large leader spot, with a moderately sized trailer and a number of smaller spots to its south and west. Also of note is moderately sized AR3774, in the south-centre disc. This has continued to see slow growth of spots within its intermediate area, along with a gradual increasing trend to its penumbral extent, while AR3777 to its east has also seeing some ongoing flux emergence but currently remains a simple bipolar group.

The CMEs associated with the X-flares have been assessed as missing. No other clear Earth-directed eruptions have been identified in imagery.

Solar Wind / Geomagnetic Activity: The slight enhancement on 04/05 Aug gradually eased with more typical background slow wind conditions returning. Solar wind speeds eased from elevated levels at just over 500km/s to be slightly elevated at 400-450kms/. Density remained at or below average. Interplanetary Magnetic Field, Bt, was Weak, below 6nT, while the north-south component was weak and variable, between -5nT and +5nT. Phi angle was initially positive (away from the Sun) but rotated to be negative (towards the Sun) at around 09/1900 UTC. Geomagnetic activity remaining Quiet (Kp0-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained below the S1 Minor Radiation Storm threshold, but rose from background in response the X1.7 flare, to peak at 3.6 pfu at 05/2140 UTC before declining towards background again. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background. The 24-hour fluence was below the Active threshold with 9.08e5 integrated pfu observed at 06/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: There are no Earth-directed CMEs, with no coronal hole fast wind arrivals expected in the period. However, weak passing transients remain possible due to the number of off the Earth-Sun line eruptions that have occurred. Geomagnetic activity is forecast to be mainly Quiet with isolated Unsettled intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to continue declining towards background levels. Should any further notable flares occur, especially in the western disc, there is the potential for flux to rise further with a slight chance of exceeding the S1/Minor Radiation Storm threshold. The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active

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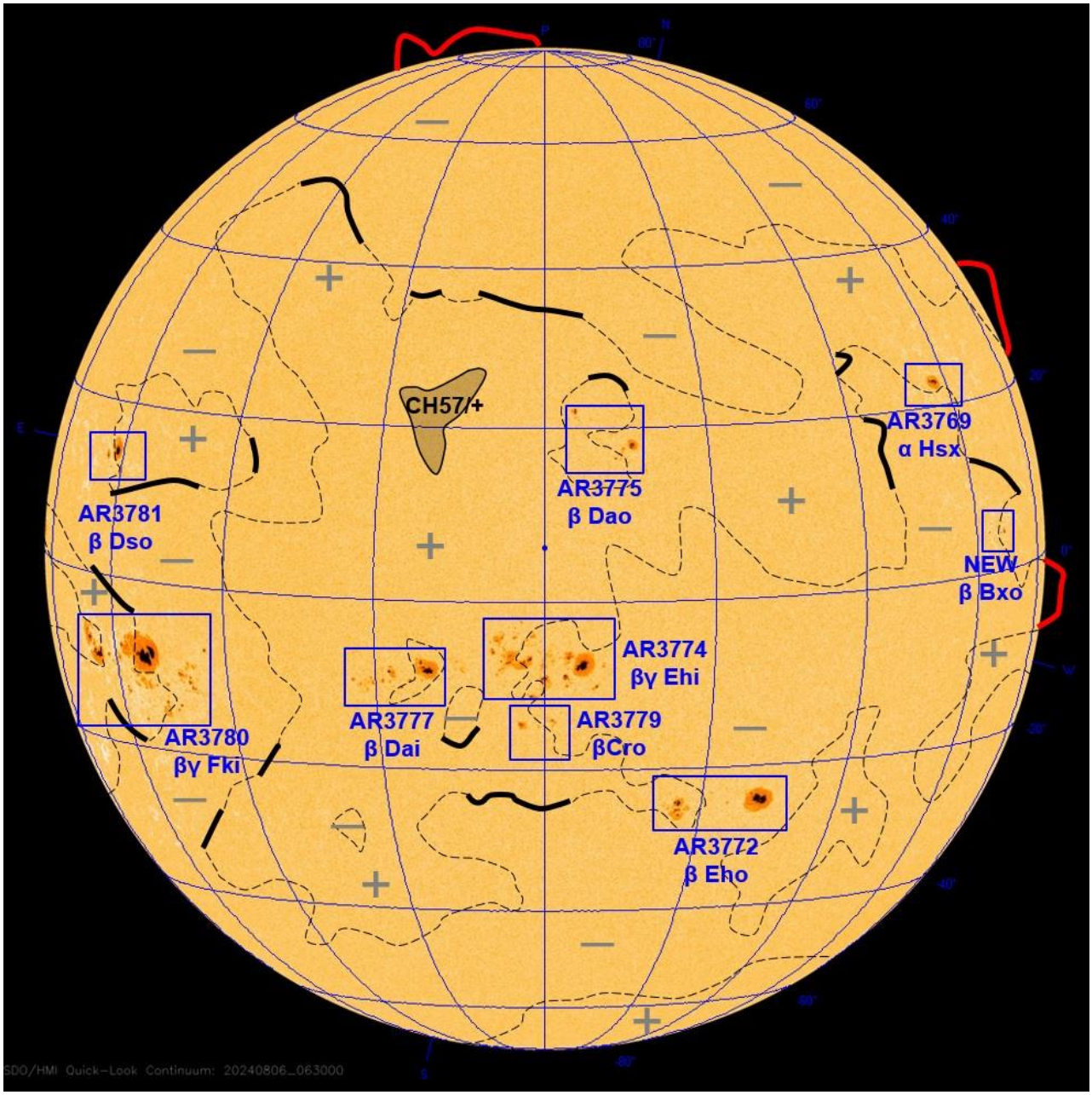
threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 06/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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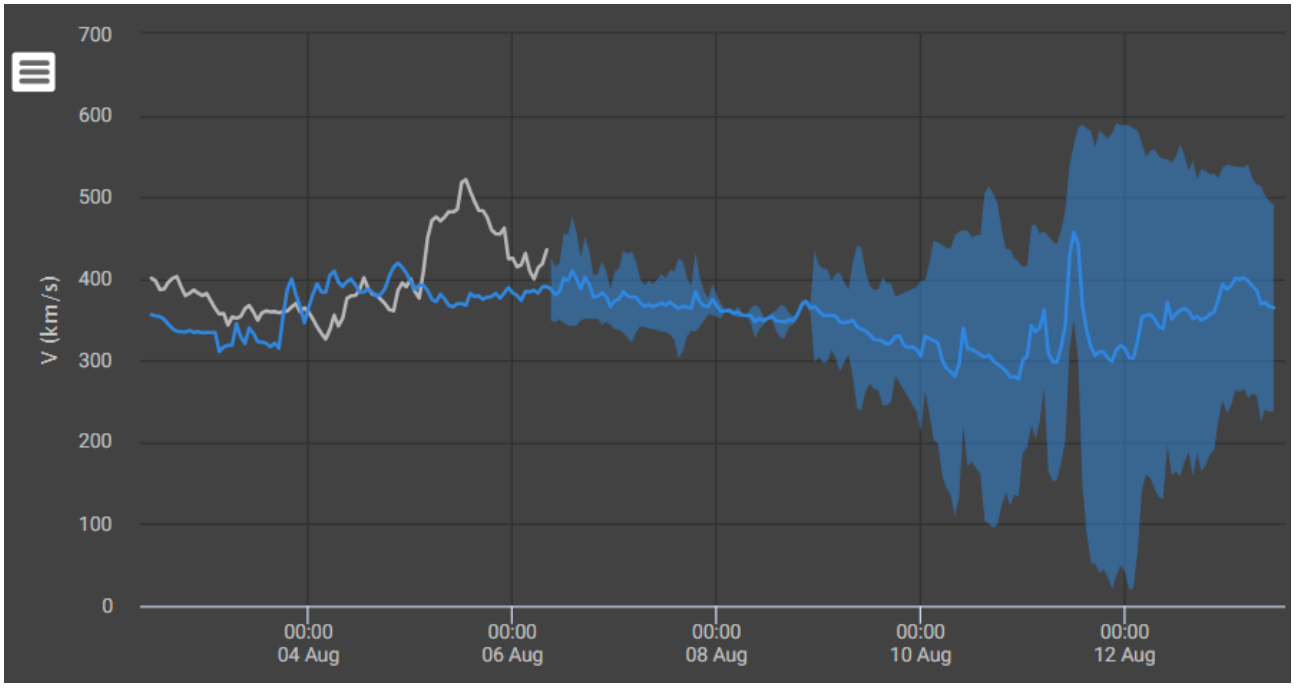
Geomagnetic Storms:

There are no Earth-directed CMEs, however given the number of CMEs that have occurred off the Earth-Sun line in recent days, some slight transient glancing effects cannot be completely ruled out, especially later in the period.

Solar winds are currently slightly elevated, having eased after recent CME and possible weak coronal hole effects. No further enhancements are currently indicated, with solar winds expected to continuing easing to, and then largely persisting at background. Geomagnetic activity is forecast to be mostly Quiet with Unsettled intervals. There is a slight chance of Active intervals alongside any transient effects that occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Solar Wind persistence model. Currently a good guide to expected solar winds, with the CME enhancement on 04-05



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Radio Blackouts - X-Ray Flares:

Moderate to High activity is expected with further M-class flares expected and a chance of isolated X-class flares.

There are nine sunspot regions on the visible disc. AR3780 remains the largest and most complex region on the disc, with a large negative leader spot, but also has a proliferation of small spots amongst a broad area of plage to its south and west. One of these was the source of the impulsive X-class flare on 05 Aug, and a mixture of ongoing development along with increasing visibility as the region moves to a less oblique angle, suggests ongoing growth and dynamical changes within these smaller spots. It is also possible that this spot could be split into a number of smaller regions.

AR3774 and AR3777 in the centre disc, are also both showing slight growth and complexification with the emergence of small intermediate spots. However these regions have remained largely stable.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	Yes	20	20	20	20

Figure 3a: GOES X-ray flux

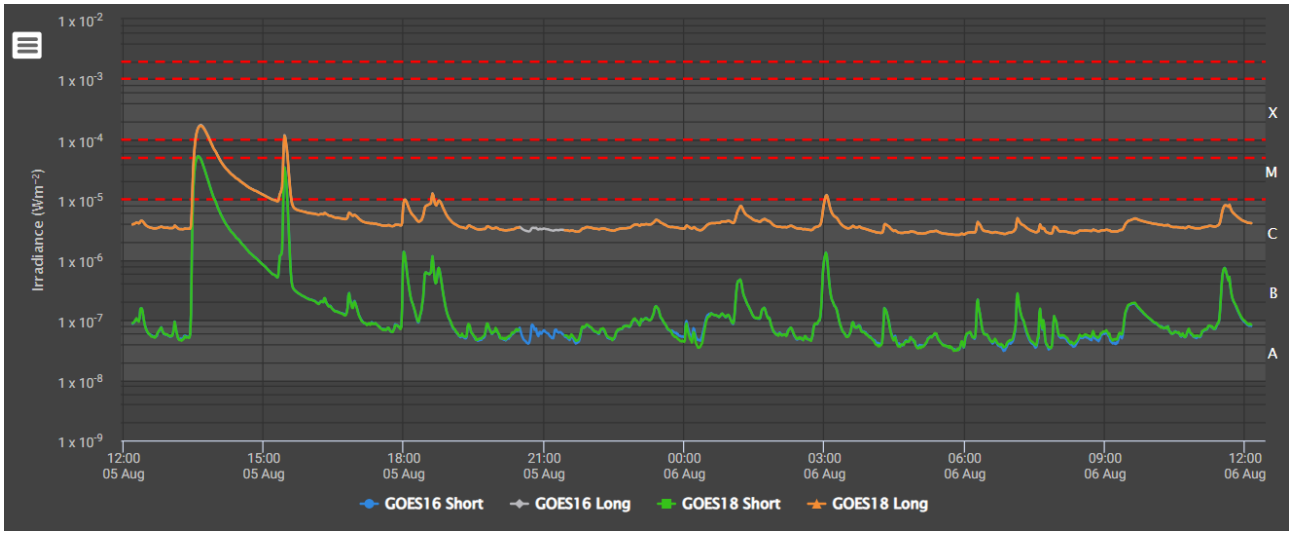

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Figure 3b: SDO-94 of X1.7 flare (left) and X1.1 flare (east)

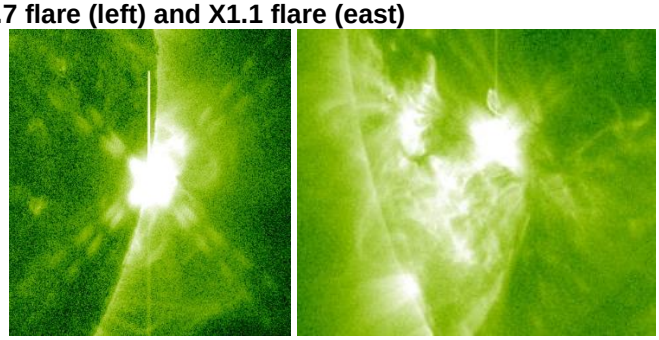


Figure 3b: SDO imagery of central disc spots

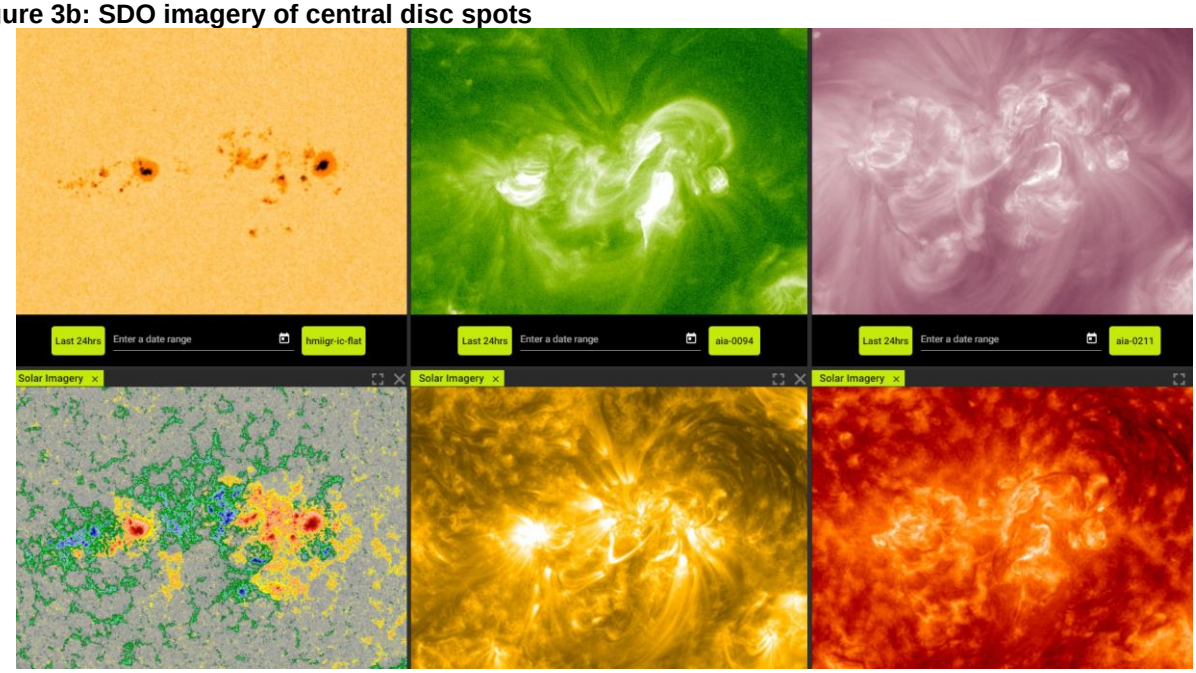
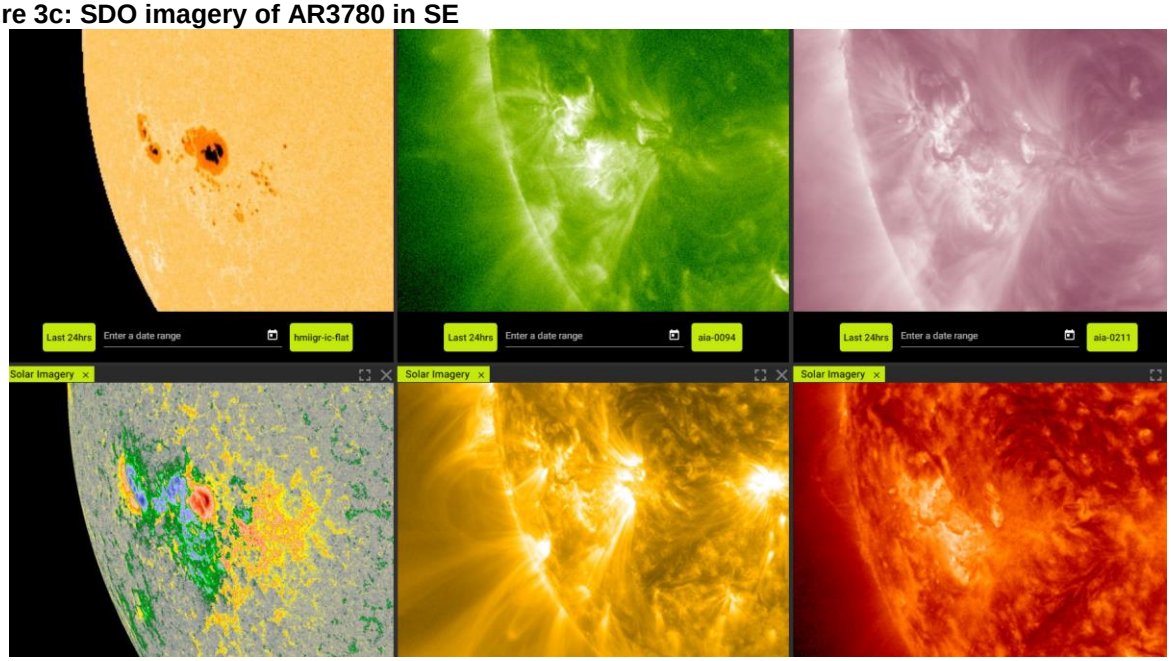


Figure 3c: SDO imagery of AR3780 in SE



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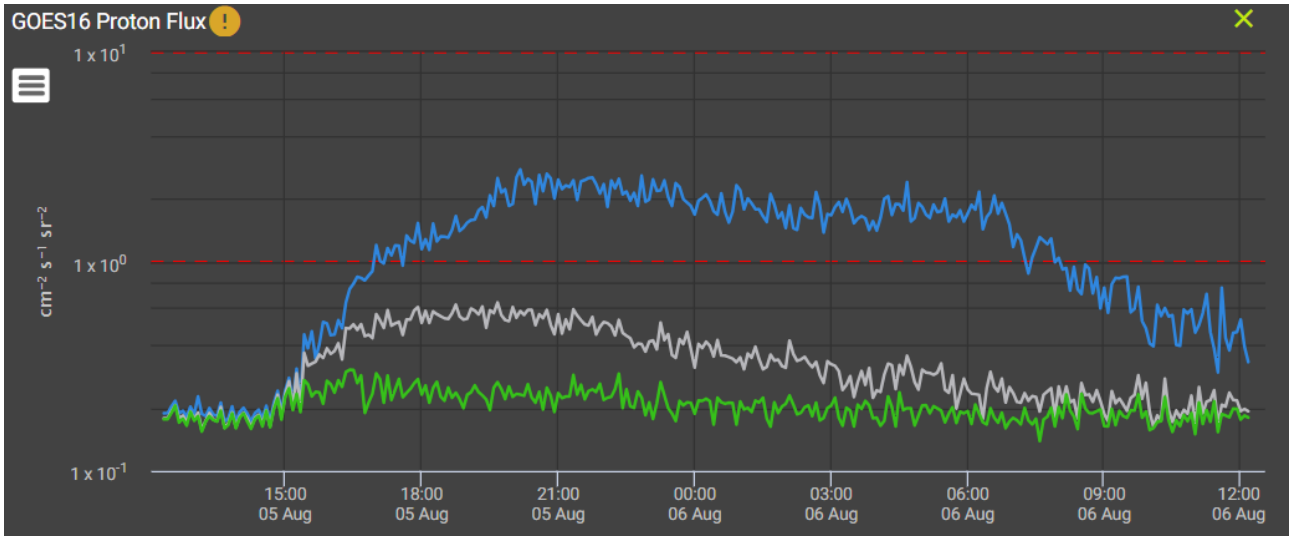
Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, rose in response to the X1.7 flare from AR3767 on the east limb, but remained below the S1 Minor Radiation Storm level. This slightly above background proton flux is expected to gradually ease towards background, however any further strong flares will bring the potential for this rising further, with a slight chance of reaching the S1 Minor Radiation storm level. While the potential for any influence from the limb AR3767 will recede day 1 and 2 (06-07 Aug), this will be tempered by an increasing risk from AR3774 and ultimately AR3780 as these regions move further west and into increasingly Earth-connected locations.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 24 hr Proton flux (10 MeV, 50 MeV and 100 MeV)



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at background. In the absence of any notable fast wind arrivals, the observed flux is expected to remain at or near background levels, perhaps rising to Moderate at diurnal peak as the Van Allen Belts relax outward after the CME arrival on 04 Apr.

The associated 24hr electron fluence is expected to remain below Active (1e8 integrated pfu), but perhaps with a slight rising trend, as indicated in MOSWOC REFM.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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